

## TITLE OF THE INVENTION

## INDUSTRIAL MACHINE MANAGEMENT SYSTEM AND METHOD

## FIELD OF THE INVENTION

- 5           The present invention relates to a management system and method for managing an industrial machine.

## BACKGROUND OF THE INVENTION

- Projection exposure apparatuses for manufacturing  
10 semiconductor devices are required to be able to project and expose a circuit pattern on a reticle surface onto a wafer surface at higher resolving power as circuits are becoming micropatterned and have higher densities. Circuit projecting and resolving power  
15 depends on the numerical aperture (NA) and exposure wavelength of a projection optical system. Hence, to improve the resolving power, a method of increasing the NA of the projecting optical system or a method of shortening the exposure wavelength is employed. For  
20 the latter method, the exposure light source has changed from g-line to i-line and is changing from the i-line to an excimer laser now. For the excimer laser, exposure apparatuses that use an oscillation wavelength of 248 or 193 nm have already been put into practical  
25 use. Currently, a next-generation exposure apparatus with an oscillation wavelength of 157 nm has been examined.



structures and materials. For example, a P-HEMT  
(Pseudomorphic High Electron Mobility Transistor)  
formed by combining compounds such as GaAs and InP,  
M-HEMT (Metamorphic-HEMT), and HBT (Heterojunction  
5 Bipolar Transistor) using SiGe or SiGeC have been  
proposed.

In the current circumstances of the semiconductor  
industry, the number of parameters to be optimized in a  
semiconductor manufacturing apparatus such as an  
10 exposure apparatus is enormous. In addition, these  
parameters are not independent but are closely related  
to each other.

Conventionally, a person in charge of apparatus  
introduction in each device manufacturer determines the  
15 parameters by trial and error. A very long time is  
required to determine optimum parameters. Even after  
parameter determination, if, e.g., a process error  
occurs, the manufacturing process may be changed in  
accordance with the error, and the parameters of the  
20 manufacturing apparatus may also have to be changed  
again. It is also time-consuming.

In production of semiconductor devices, time to  
be taken from the setup of a manufacturing apparatus to  
the start of mass production is limited. Time taken to  
25 determine parameters is also limited. From the  
viewpoint of COO (Cost Of Ownership) as well, the  
operation time of the manufacturing apparatus must be

increased, and therefore, the parameters that are determined once must be quickly changed. In such a situation, it is very difficult to manufacture various semiconductor devices with optimum parameters. Even a  
5 manufacturing apparatus capable of obtaining high yield cannot obtain the expected yield because it is used without optimizing the parameters, resulting in an unnoticeable decrease in yield. Such a decrease in yield increases the manufacturing cost and decreases  
10 the delivery amount, and additionally, decreases the competitive power.

The parameters of a manufacturing apparatus can be quickly determined probably not by the user of the manufacturing apparatus but by a person in charge of  
15 manufacturing, sales, or maintenance of the manufacturing apparatus or a person in charge of services about the manufacturing apparatus (such a person will be referred to as a vendor hereinafter). This is because the vendor knows the characteristics of  
20 the manufacturing apparatus better and has information that is not public to the user. However, from the viewpoint of schedule adjustment and transmit time, it is not always the best to make the vendor actually visit the factory where the manufacturing apparatus is  
25 installed.

For a successful semiconductor business, it is very important to solve any trouble in manufacturing

apparatus. Japanese Patent Laid-Open No. 11-15520 has proposed an epoch-making system that quickly solves any trouble in industrial machine such as a semiconductor manufacturing apparatus from a remote site. In this  
5 system, a monitoring apparatus for monitoring the operation state of an industrial machine and a management apparatus on a vendor side are connected through a data communication network such as the Internet, thereby maintaining the industrial machine  
10 while exchanging information related to the maintenance of the industrial machine therebetween.

#### SUMMARY OF THE INVENTION

It is an object of the present invention to -  
15 provide an advanced system of the above-described maintenance system. More specifically, it is an object of the present invention to provide a system and method capable of quickly and easily optimizing the parameters of an industrial machine or solving any trouble in  
20 industrial machine.

According to the first aspect of the present invention, there is provided a management system for managing an industrial machine using a data communication network, comprising a management  
25 apparatus for selectively giving an operation right of the industrial machine to one of a first operation apparatus arranged in a factory where the industrial

machine is installed and a second operation apparatus arranged at a remote site from the factory where the industrial machine is installed, and a control apparatus for operating the industrial machine in accordance with an instruction from the operation apparatus to which the operation right has been given by the management apparatus and providing information representing an operation condition of the industrial machine to the operation apparatus.

10           According to the preferred aspect of the present invention, the second operation apparatus and the control apparatus are preferably connected through the data communication network.

15           According to the preferred aspect of the present invention, the management apparatus preferably selectively gives the operation right of the industrial machine to one of the first and second operation apparatuses in accordance with an instruction from a manager of the industrial machine.

20           According to the preferred aspect of the present invention, preferably, the system further comprises a manager setting section for setting the manager of the industrial machine, and the management apparatus selectively gives the operation right of the industrial machine to one of the first and second operation apparatuses in accordance with an instruction from the manager set by the manager setting section.



operation apparatus in accordance with an instruction from the first operation apparatus and makes some or all pieces of information, which are secret to the first operation apparatus, public to the first

5 operation apparatus in accordance with an instruction from the second operation apparatus.

According to the preferred aspect of the present invention, preferably, when the operation right of the industrial machine is given to the first operation  
10 apparatus, the security system makes the information representing the operation condition of the industrial machine public to the second operation apparatus in accordance with an instruction from the first operation apparatus, and when the operation right of the  
15 industrial machine is given to the second operation apparatus, the security system makes the information representing the operation condition of the industrial machine public to the first operation apparatus in accordance with an instruction from the second  
20 operation apparatus.

According to the preferred aspect of the present invention, the second operation apparatus is preferably arranged in a business office of a person in charge of manufacturing, sales, or maintenance of the industrial  
25 machine or a person in charge of services about the industrial machine.

According to the preferred aspect of the present



invention, the industrial machine preferably comprises a semiconductor manufacturing apparatus such as an exposure apparatus, CVD apparatus, etching apparatus, CMP apparatus, resist coating apparatus, development  
5 apparatus, ashing apparatus, or inspection apparatus.

According to the second aspect of the present invention, there is provided a management method of managing an industrial machine using a data communication network, comprising the management step  
10 of selectively giving an operation right of the industrial machine to one of a first operation apparatus arranged in a factory where the industrial machine is installed and a second operation apparatus arranged at a remote site from the factory where the  
15 industrial machine is installed, and the control step of sending an instruction from the operation apparatus to which the operation right has been given in the management step to a control apparatus of the industrial machine to cause the control apparatus to  
20 control the industrial machine and sending information representing an operation condition of the industrial machine from the control apparatus to the operation apparatus.

Other features and advantages of the present  
25 invention will be apparent from the following description taken in conjunction with the accompanying drawings, in which like reference characters designate

the same or similar parts throughout the figures thereof.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated  
5 in and constitute a part of the specification,  
illustrate embodiments of the invention and, together  
with the description, serve to explain the principles  
of the invention.

Fig. 1 is a block diagram showing the  
10 configuration of an industrial machine management  
system according to a preferred embodiment of the  
present invention;

Fig. 2 is a flow chart showing the operation of a  
management apparatus based on a management program;

15 Fig. 3 is a flow chart showing the operation of a  
vendor-side operation apparatus based on an operation  
program; and

Fig. 4 is a flow chart showing the operation of a  
factory-side operation apparatus based on an operation  
20 program.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferred embodiment of the present invention  
will be described below with reference to the  
25 accompanying drawings.

Fig. 1 is a block diagram showing the  
configuration of an industrial machine management

In each factory 100, an industrial machine 110, a management apparatus 120 for managing the industrial machine, and a factory-side operation apparatus (first operation apparatus) 130 for operating the industrial machine 110 through the management apparatus 120 are installed. Examples of the industrial machines 110 to be managed are semiconductor manufacturing apparatuses such as an exposure apparatus, CVD apparatus, etching apparatus, CMP apparatus, resist coating apparatus, development apparatus, ashing apparatus, and inspection apparatus.

The factory-side operation apparatus 130 can operate the industrial machine 110 through the management apparatus 120. Some or all of the industrial machine 110, management apparatus 120, and factory-side operation apparatus 130 may be integrated. The factory-side operation apparatus 130 typically includes a monitor 131 for monitoring various operation states of the industrial machine 110 or checking parameters, an input section 132 for inputting information (e.g., parameters, commands, and programs)



characteristics of the industrial machine 110 well,  
e.g., a person in charge on the factory 100 side to  
optimize the parameters and to solve a trouble while  
operating the industrial machine 110, as in the prior  
5 art, and even if it is possible, a very long time is  
required. In addition, from the viewpoint of schedule  
adjustment and transmit time, it is not speedy to allow  
a person in charge on the vendor 200 side to visit the  
factory 100 each time to perform the above operation.

10 As is apparent from the above description, when the  
industrial machine 110 is a semiconductor manufacturing  
apparatus such as an exposure apparatus, the advantage  
of this management system becomes more conspicuous.

The vendor-side operation apparatus 210 typically  
15 includes a monitor 211 for monitoring various operation  
states of the industrial machine 110 or checking  
parameters, an input section 212 for inputting  
information (e.g., parameters, commands, and programs)  
to be used to operate the industrial machine 110, and  
20 an operation program 213 for controlling the operation  
of the vendor-side operation apparatus 210.

The management apparatus 120 includes a manager  
setting section 121 for setting the manager of the  
industrial machine 110, a management program 122 for  
25 controlling the management system, a factory-side  
memory 123 to be exclusively used by the factory 100  
side, a vendor-side memory 124 to be exclusively used

by the vendor 200 side, an information management  
section 125 for controlling an access to the  
factory-side memory 123 and vendor-side memory 124, and  
a control apparatus 126 for operating the industrial  
5 machine 110 in accordance with an instruction from the  
factory-side operation apparatus 130 or vendor-side  
operation apparatus 210 and providing information  
representing the operation condition to the  
factory-side operation apparatus 130 or vendor-side  
10 operation apparatus 210.

The manager setting section 121 can set the  
manager, e.g., in accordance with mechanical operation  
on switches or buttons, on the basis of information  
(e.g., a special code) sent from the factory-side  
15 operation apparatus 130, vendor-side operation  
apparatus 210, or another terminal, or in accordance  
with another method. Typically, before the industrial  
machine 110 is installed in the factory 100 by the  
vendor 200, and acceptance inspection and the like are  
20 done by a person in charge in the factory 100, the  
industrial machine 110 is managed by the vendor 200.  
After that, the industrial machine 110 is managed by  
the factory 100. The management program 122  
selectively gives the operation right of the industrial  
25 machine 110 to the factory-side operation apparatus 130  
or vendor-side operation apparatus 210 and allows the  
operation apparatus having the operation right to

operate the industrial machine 110. The operation  
right of the industrial machine 110 is given to an  
appropriate operation apparatus typically in accordance  
with an instruction from the manager set by the manager  
5 setting section 121 or a permission from the manager.

The factory-side memory 123 is used to, e.g.,  
store, of various kinds of information such as the  
operation log of the industrial machine 110 or the  
parameters set for the industrial machine 110 on the  
10 factory 100 side, information that must be secret to  
the vendor 200 side. The information management  
section 125 normally inhibits the vendor 200 side (i.e.,  
the vendor-side operation apparatus 210) from accessing  
the factory-side memory 123 but permits the vendor 200  
15 side to access some or all pieces of information stored  
in the factory-side memory 123 in accordance with a  
permission given from the factory 100 side.

The vendor-side memory 124 is used to, e.g.,  
store, of various kinds of information such as the  
20 operation log of the industrial machine 110 or the  
parameters set for the industrial machine 110 on the  
vendor 200 side, information that must be secret to the  
factory 100 side. The information management section  
125 normally inhibits the factory 100 side (i.e., the  
25 factory-side operation apparatus 130) from accessing  
the vendor-side memory 124 but permits the factory 100  
side to access some or all pieces of information stored

in the vendor-side memory 124 in accordance with a permission given from the vendor 200 side as needed.

Fig. 2 is a flow chart showing the operation of the management apparatus 120 based on the management program 122. In step S401, the management apparatus 120 receives an operation request of the industrial machine 110 from the factory-side operation apparatus 130 or vendor-side operation apparatus 210. In step S402, the management apparatus 120 determines whether the factory-side operation apparatus 130 has issued the operation request. If YES in step S402, the flow advances to step S403. Otherwise, the flow advances to step S409.

In step S403, it is determined whether the current manager of the industrial machine 110, i.e., the manager set by the manager setting section 121 is on the factory 100 side. If YES in step S403, the flow advances to step S404. Otherwise (i.e., if the manager is on the vendor 200 side), the flow advances to step S407.

If YES in step S403, it means that the manager himself/herself is requesting the operation of the industrial machine 110. Hence, in step S404, the management apparatus 120 gives the operation right of the industrial machine 110 to the factory-side operation apparatus 130 related to the operation request. In step S405, the management apparatus 120







step S411, the management apparatus 120 causes the control apparatus 126 to operate the industrial machine 110 in accordance with an instruction from the vendor-side operation apparatus 210 and also acquires  
5 information representing the operation condition of the industrial machine 110 from the industrial machine 110 and transmits the information to the vendor-side operation apparatus 210. The vendor-side operation apparatus 210 displays the operation condition of the  
10 industrial machine 110 on, e.g., the monitor 211 in accordance with the information.

The management apparatus 120 may transmit the information representing the operation condition of the industrial machine 110 that is being operated by the  
15 vendor-side operation apparatus 210 to the factory-side operation apparatus 130 in accordance with an instruction from the vendor-side operation apparatus 210.

In step S412, it is determined whether the  
20 operation of the industrial machine 110 by the vendor-side operation apparatus 210 is to be ended (e.g., whether a command indicating the end of the operation has been received). If YES in step S412, the flow returns to step S401.

25 If it is determined in step S409 that the current manager of the industrial machine is on the factory 100 side, the management apparatus 120 determines in step



flow advances to step S507 to display an error message on the monitor 211 (corresponding to step S408).

In step S503, the vendor-side operation apparatus 210 outputs an instruction to the management apparatus 120 through the data communication network 300 to  
5 operate the industrial machine 110 in accordance with the operation on the input section 212 by the person in charge on the vendor 200 side (corresponding to step S405). In step S504, the vendor-side operation  
10 apparatus 210 receives information representing the operation condition of the industrial machine 110 from the management apparatus 120 through the data communication network 300 (corresponding to step S405).

In step S505, the vendor-side operation apparatus  
15 210 analyzes the information received from the management apparatus 120 and outputs the result to the monitor 211 or the like.

In step S506, it is determined whether the operation of the industrial machine 110 is to be ended.  
20 If YES in step S506, the flow advances to step S508 to execute end processing (e.g., a command indicating the end of the operation is transmitted to the management apparatus 120).

Fig. 4 is a flow chart showing the operation of  
25 the factory-side operation apparatus 130 based on the operation program 133. In step S601, the factory-side operation apparatus 130 transmits the operation request

of the industrial machine 110 to the management apparatus 120 in accordance with the operation on the input section 132 by a person in charge on the factory 100 side (corresponding to step S401).

5           In step S602, the factory-side operation apparatus 130 determines whether the operation right of the industrial machine 110 has been given by the management apparatus 120. If YES in step S602 (corresponding to step S410), the flow advances to step 10 S603. If NO in step S602 (corresponding to "NO" in step S413), the flow advances to step S610 to display an error message on the monitor 131 (corresponding to step S414).

          In step S603, the factory-side operation 15 apparatus 130 determines whether the industrial machine 110 is to be operated in the test mode. If YES in step S603, the flow advances to step S604. If the industrial machine 110 is to be operated in another mode (e.g., mass production mode), the flow advances to 20 step S608 to operate the industrial machine 110 in accordance with that mode.

          In step S604, the factory-side operation apparatus 130 outputs an instruction to the management apparatus 120 through to operate the industrial machine 25 110 in accordance with the operation on the input section 132 by the person in charge on the factory 100 side (corresponding to step S411). In step S605, the

factory-side operation apparatus 130 receives information representing the operation condition of the industrial machine 110 from the management apparatus 120 (corresponding to step S411).

5 In step S606, the factory-side operation apparatus 130 analyzes the information received from the management apparatus 120 and outputs the result to the monitor 131 or the like.

In step S607, it is determined whether the  
10 operation of the industrial machine 110 is to be ended. If YES in step S607, the flow advances to step S609 to execute end processing (e.g., a command indicating the end of the operation is transmitted to the management apparatus 120).

15 According to the present invention, a method and system for operating an industrial machine from a remote site and checking the operation condition can be provided. These system and method can quickly and easily optimize the parameters of the industrial  
20 machine or solve any trouble in industrial machine.

As many apparently widely different embodiments of the present invention can be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the specific  
25 embodiments thereof except as defined in the appended claims.